

***Pseudolucia balinti* sp. n. of the plumbea-sibylla species group
in Central-West Argentina (Lepidoptera, Lycaenidae: Polyommatainae)**

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Abstract – *Pseudolucia balinti* sp. n., an isolated, locally relict butterfly flying in the desiccated Precordillera de los Andes at Sierra del Tontal, Calingasta, San Juan, Argentina, is described. Its unique life history and systematic status within the genus are presented and discussed. With 18 figures and one table.

Key words – Argentina, host plants family tree, isolation, Lepidoptera, Lycaenidae, Polyommatainae, Precordillera de los Andes

INTRODUCTION

Since the early 1990's, the author has concentrated his efforts in the field in order to study the biology, ethology and distribution of the polyommataine genus *Pseudolucia* Nabokov, 1945. This ongoing campaign of annual expeditions to Chile and Argentina resulted in no fewer than 19 new species to Chile and one new species to Argentina (BÁLINT & JOHNSON 1993, BÁLINT & JOHNSON 1995a, b, BENYAMINI *et al.* 1995a, b, c, BÁLINT & BENYAMINI, 2001, BÁLINT *et al.* 2001, BENYAMINI & BÁLINT 2011). Therefore, while the description of Chilean new taxa received priority for the publication of an updated list of the Chilean butterflies (BENYAMINI *et al.* 2013), the Argentine fauna was still undergoing fieldwork along thousands of kilometres of the Andes and Patagonia.

As the research advanced, it became clear to the author that the wide distribution of the genus *Pseudolucia* in Argentina, with its ability to tolerate different habitats, together with the availability of many potential host plants, may yet hide unknown species. To uncover these species, while their existence was yet unthreatened by development and environmental change, the author started to make cross-continent transects from the Andes to the Atlantic Ocean. In central-west Argentina, these transects were carried out from Mendoza to San Luis and from

San Juan to Cordoba provinces. The Precordillera de los Andes running parallel and about one hundred kilometres east of the Andes, with summits at *ca.* 4000 m was particularly intriguing. Three areas of this mountain chain were checked (Fig. 1): Mendoza Precordillera in its southern limit (peaking at 4316 m), Sierra del Tontal in the middle (4366 m) and Sierra del Tigre (3810 m) in the north – the last two transects being in San Juan province. The results were poor but quite astonishing; only one unknown *Pseudolucia* species was found at Sierra del Tontal, but it is of importance and probable future interest to reconstruct the evolution of the *Pseudolucia* species groups, *andina* and *plumbea-sibylla* as will be shown below.

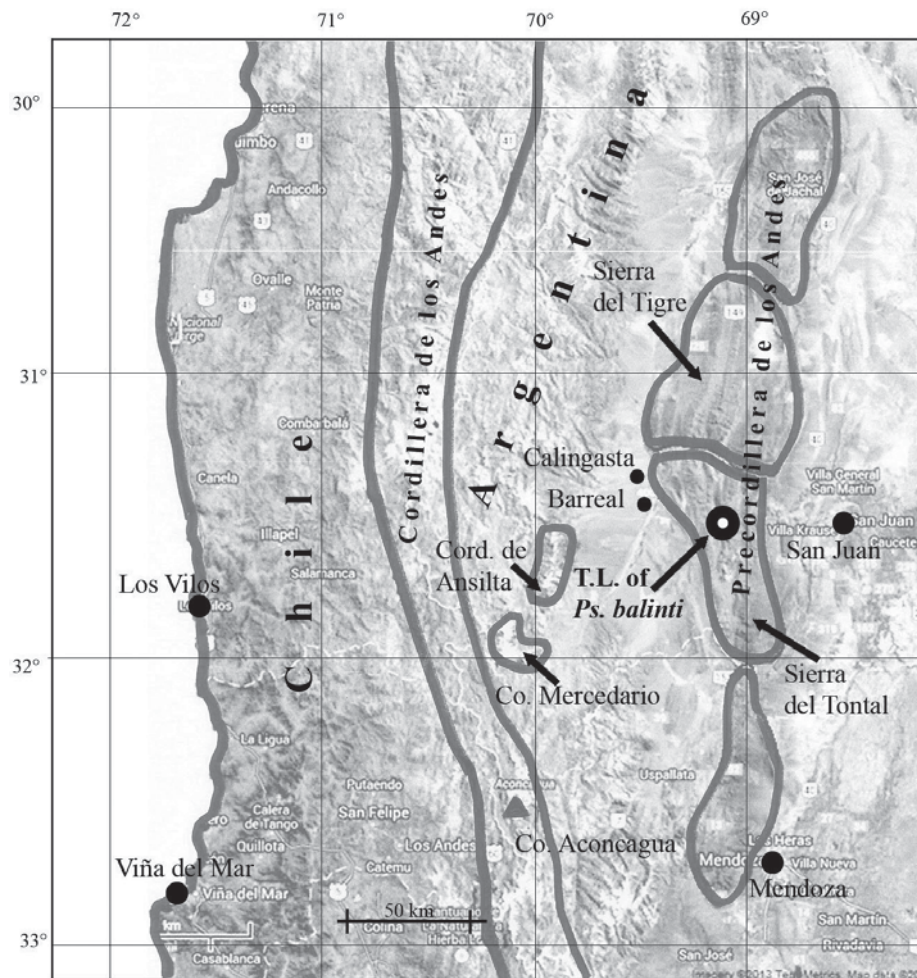


Fig. 1. Map of the Argentine Precordillera de los Andes indicating the location of *Pseudolucia balinti* sp. n., type locality at Sierra del Tontal (credit: L. Benyamini)

MATERIAL AND METHODS

The material examined is deposited in the extensive *Pseudolucia* collection of the author. For comparative purposes, ~400 specimens representing the *plumbea* group collected in Chile and Argentina were consulted. Methods and terminologies are compatible with the previous papers published on the genus (BÁLINT *et al.* 2001, BENYAMINI & BÁLINT 2011).

Genital structures in dissected specimens were measured and recorded in the same manner as in BENYAMINI & BÁLINT (2011), by using OLYMPUS SZX12 binocular optical microscope with ocular accessory GSWH X/22 under magnification $\times 90$.

Distribution and biology of the species are compiled according to the database of the author.

Abbreviations – Depositories: HNHM = Hungarian Natural History Museum (Budapest, Hungary); IADIZA = Instituto Argentino de Investigaciones de las Zonas Áridas – Centro Regional de Investigaciones Científicas y Tecnológicas (Mendoza, Argentina).

Persons: AB = Avishai Benyamini, DB = Dubi Benyamini, EB = Eran Benyamini, OT = Ofir Tomer, ZsB = Zsolt Bálint.

Genitalia measurements: AB = valval length line measured from valva base to lower projection terminus, C = point on valval length where the highest distance is measured on valval length line perpendicularly to lower costa, CD = highest valval width measured from C; E = point on valval length line, where the highest distance is measured perpendicularly to upper costa; EF = highest valval width measured from E (all in mm).

RESULTS

Pseudolucia balinti sp. n.

(Figs 2–7)

Type material – Holotype, male, forewing costal length 9 mm, labelled as: “Argentina, San Juan [/] Calingasta [/] Precordillera de Los Andes [/] Sierra del Tontal, over Barreal [/] 3340 m [/] 29/11/2010 [/] Leg. Ofir Tomer” (printed) (Figs 2–3). Paratype (“allotype”), female, forewing costal length 9.5 mm, labelled as: “Argentina, San Juan [/] Sierra Tontal [/] 3464 m [/] 15.12.2009 [/] Leg. Avishai Benyamini” (printed) (Figs 4–5). Both types will be deposited in the IADIZA.

Paratypes (n = 41), all from Sierra Tontal – Nos 1–7, males: 15.12.2009, 3308 m, leg. DB; no. 8, male: ditto, leg. EB; nos. 9–10, male: ditto, leg. AB; no.

11, male: ditto, but 3464 m, leg. AB; no. 12, female, ditto, but 3308 m, leg. AB; no. 13, female: ditto, but 3497 m, leg. EB; no. 14, male: ditto, but 29.11.2010, 3340 m, leg. OT (genit. prep. no. 1371 ZsB); nos 15–17, males: ditto, but 3340 m, leg. OT; no. 18, male: ditto, 3350 m, leg. OT; nos. 19–20, males: ditto, but 3350 m, leg. DB; no. 21, male: ditto, but 3640 m, leg. DB; nos. 22–27, males: ditto, but 3640 m, leg. OT; nos 28–33, females: 29.11.2010, 3640 m, leg. DB (no. 28 dissected: genit. prep. no. 1372, ZsB); no. 34, female: 9.12.2011, leg. OT; no. 35, male: ditto, but 3201 m, leg. DB; no. 36, male: ditto, but 3330 m, leg. OT; nos 37–39, males: ditto, but 3580 m, leg. DB; no. 40, female: ditto, but 3580 m, leg. DB; no. 41: from egg 3.12.2011 on *Astragalus arequipensis* 3580 m, hatched 8.1.2012, leg. OT.

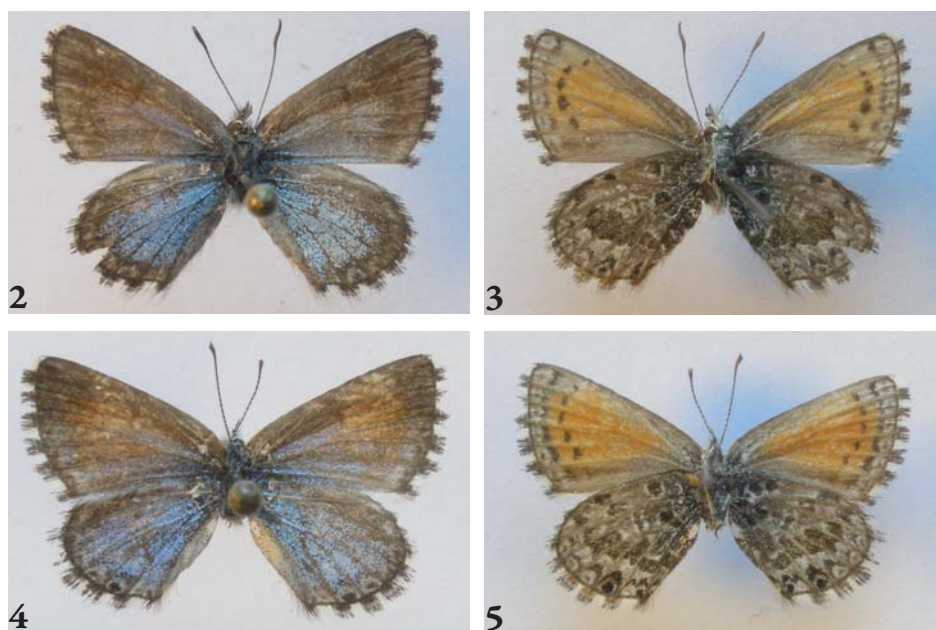
Paratype nos 6 & 32 will be deposited in HNHM, Paratype nos. 7 & 33 will be contributed to the butterflies collection at Miguel Lillo Institute in Tucumán, Argentina. All the remaining paratypes are in the authors' collection.

Type measurements (in mm): Male forewing upper costal length = 9 (holotype). Female forewing upper costal length = 9.5 (allotype). Male paratype forewing costal lengths are 7.3 mm to 10.5 mm with an average of 8.88 mm (n = 32). At 3308 m (only *Adesmia* host plant present) the average length is 8.50 mm (n = 10), at 3450 m 8.86 mm (n = 3), at 3580 m 8.87 mm (n = 4) and at 3640 m (dominated by the preferred *Astragalus* host plant) 9.97 mm (n = 7). Female paratype forewing costal lengths are 8.3 mm to 10.6 mm with an average of 9.36 mm (n = 9), nearly 0.5 mm larger than the average male.

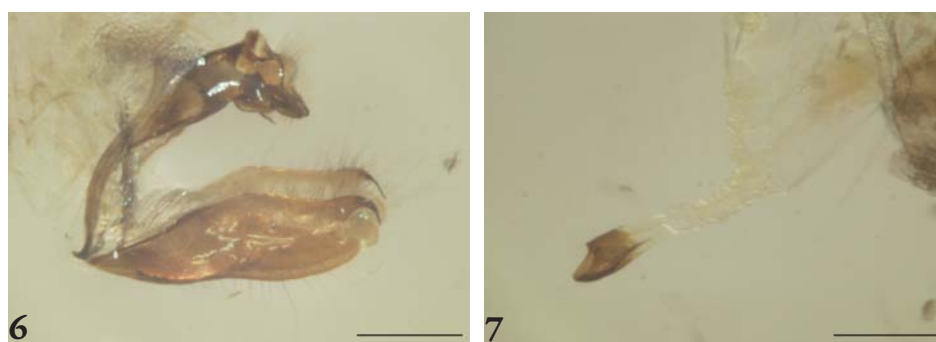
Description and diagnosis – Male (Fig. 2) and female (Fig. 4) wing dorsal surface blue in general with long white fringes melanised at vein termini. Male forewing blue restricted to basal area, hindwing medial area blue, submargin black with submarginal markings. Female forewing apex black medial and basal area orange, hindwing blue without black border, but with submarginal markings. Wing ventral surface in both sexes (Figs 3, 5) with complete “plumbea-like” pattern with larger ruptive elements in medial band and somewhat lighter basal markings (see BÁLINT & JOHNSON 1993, fig. 2). The species closely resembles to *P. plumbea* hitherto known only from Chile, but the male forewing upper-side ground colour with reduced lighter blue colouration (fully darker blue in *P. plumbea*), the hindwing submarginal markings lighter and well visible (faint, vestigial or missing in *P. plumbea*), the hindwing ventral pattern in both sexes are lighter and the medial spots are distinct (darker and vestigial in *P. plumbea*).

The genitalia (Figs 6–7) are typical of the *plumbea* species group (see BÁLINT & JOHNSON 1993: 10–11): male (Fig. 6) uncus large and wide but blunt and short; gnathos narrow and curved; dorsal tegumen heavily sclerotised and humped in lateral view, ventral part with membranous appendix angularis in both sides; vinculum normal, two armed juxta present with sclerotised spine and membranous edges; aedeagus with subzonal and short suprazonal parts equal in

length, subzonal broadening cephalic, suprazonal pointing caudad; zone with a double membranous flip and sagram without setae; valve elongate and robust with flat upper costa without angulation, lower costa slightly waved, upper valval terminus with a large pointed hook heavily sclerotised and covered by sensory hairs, lower terminus lobated, membranous and rounded. Female genitalia (Fig.



Figs 2–5. *Pseudolucia balinti* sp. n.: 2 = holotype male, Sierra del Tontal, 3340 m, 29.11.2011, leg. Ofir Tomer (forewing costa length: 9.0 mm), dorsal view, 3 = ventral view, 4 = paratype (“allotype”) female, Sierra del Tontal, 3464 m, 15.12.2009, leg. Avishai Benyamini (forewing costa length: 9.5 mm), dorsal view, 5 = ventral view (photo: G. Katona)



Figs 6–7. *Pseudolucia balinti* sp. n.: 6 = holotype genitalia in lateral view, 7 = paratype (“allotype”) genitalia in lateral view (scale bar = 0.1 mm) (photo: Zs. Bálint)

7) with short eversible tube with laterally membranous and wider and longer cephalic part, and with a short, narrow and plated membranous caudal part, ostium wide and sclerotised with large terminal oval opening. The genitalia in males may differ from *plumbea* having an almost, or only slightly concave, upper edge behind the point C towards point B. The upper valval projection is less curved inwardly and seems to be less robust, as well as the lower projection which does not contact the upper one.

Measurements of male genital valva in holotype: AB = 1.6, C = 0.9, CD = 0.3, E = 0.7, EF = 0.25; male genital valva in HNHM paratype 1: AB = 1.6, C = 1.0, CD = 0.18, E = 0.75, EF = 0.25.

Early stages – Egg (Fig. 8): females crawled among leaves of *A. arequipensis* plants to lay eggs. Eighteen single eggs were found 3–7 cm inside the host plants, usually at their lower periphery. Eight eggs (44.5%) were found on the leaflets, six (33.3%) at the base of flower buds or flowers and four (22.2%) on the leaf petioles. The egg is typically polyommataine, white when laid or with a green tint. Diameter is 0.5–0.6 mm.

Larva: L1 does not consume the egg-shell. It is 1.0 mm long, light green or yellowish-green with long bright hairs and a black head. It eats a hole in the leaflet's epidermis consuming the soft tissue beneath, thus creating a typical transparent round 'window'. L3 & L4 are whitish-light green identical to the colour of the leaflets, with six longitudinal rows of white hairs. The head is glossy dark-brown. The final (fifth) instar is 8.5 mm long at rest and 9.5–10 mm in motion. It is pinkish-white (Fig. 9), the whole body covered with short white hairs. In its final stage it is pink with white setae, each segment with three diagonal white-pink stripes on its flanks. The head remains a glossy dark-brown.

Prepupa: horizontal, pink, attached by cremaster and girdle, 7 mm long.

Pupa (Fig. 10): brown, 7 mm long, held by a rear cremaster and a thoracic girdle connected to the wing cases on both sides. The single reared specimen eclosed after 11 days, being a second brood male.

Winter diapause possibly as a fully-grown larva. No diapausing larvae or pupae were found under stones near the host plant or beneath it when digging it out, supporting our suspicion that the diapausing larvae in this habitat remain below ground in the nest of the host ants. It is also assumed that some larvae may overwinter below ground elsewhere.

Etymology – This species is dedicated to my friend and collaborator in the last 20 years on the Neotropical genus *Pseudolucia*: Dr Zsolt Bálint, curator of butterflies in the HNHM at Budapest. He is a prolific author and a known world authority of numerous publications on lycaenids. Zsolt is a known contributor to the study of Nabokov Lepidopterology heritage and quite impressively is a gifted poet and musician.

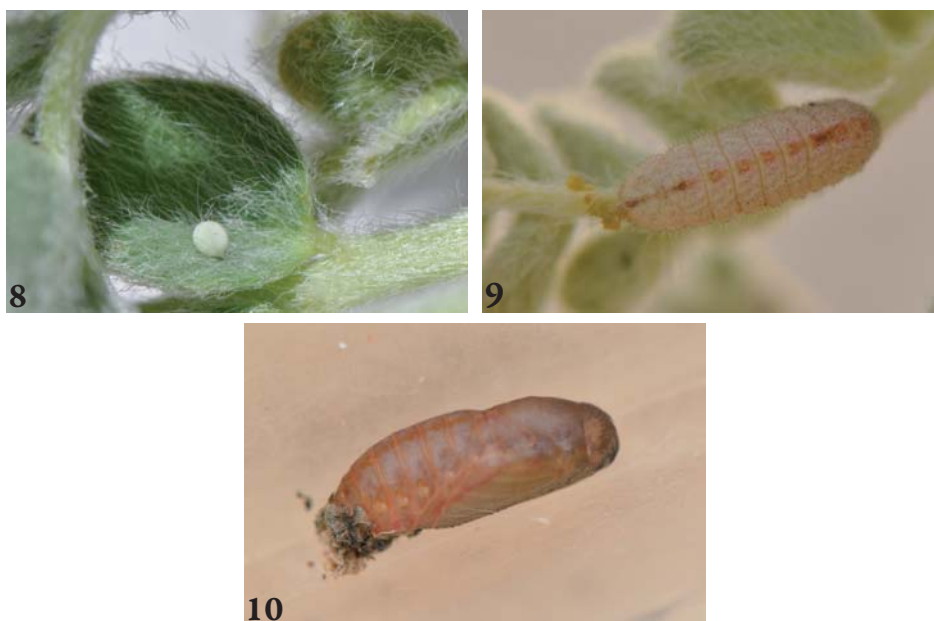
Distribution – Presently known from the western slopes of Precordillera de los Andes, Sierra del Tontal, Calingasta, San Juan, Argentina, flying between 3200 m and 3928 m above sea level. The habitat stretches along ca 6 km (Fig. 11).

Flight period – Late November at least to January in two (or more) annual broods (Figs 12–13).

Adult nectar sources – At the breeding site, adults preferentially sought nectar from the violet-white flowers of the dominant prostrate *Junellia* sp. (Verbenaceae), pink flowers of *Glandularia* sp. (Verbenaceae) (det. R. Kiesling), but also from flowers of both host plants, *Astragalus* and *Adesmia* spp.

Other butterflies flying with P. balinti – Pieridae: *Phulia nymphula* (Blanchard, 1852) and *Colias flaveola* Blanchard, 1852; Nymphalinae: *Yramea modesta* (Blanchard, 1852), *Y. lathonioides* (Blanchard, 1852), *Vanessa carye* (Hübner, [1812]) and *V. braziliensis* (Moore, 1883). Satyrinae: *Argyrophorus monticolens* (A. Butler, 1881). Hesperiiidae: *Hylephila* sp. and *Pyrgus* sp. No other lycaenids were observed in *balinti* habitats but at a lower habitat at 2500 m, a small the-cline-like butterfly, resembling *Strymon eurytulus* (Hübner, 1819) was bred on the prostrate pink-flowered cfr. *Sphaeralcea philipiana* Krapov (Malvaceae).

Myrmecophily – A dorsal nectary organ (DNO) was observed at least from L3 larva to the last instar. Under some host plants we found nests of *Dorymyrmex*



Figs 8–10. Early instars of *Pseudolucia balinti* sp. n., 3580 m, Sierra del Tontal (San Juan, Argentina): 8 = egg on a leaflet of *Astragalus arequipensis*, 2.12.2011, 9 = last instar caterpillar on *Astragalus arequipensis*, 13.12.2011, 10 = pupa, 28.12.2011 (photo: D. Benyamini)

chilensis Forel, 1911. This ant is known to host larvae of other *Pseudolucia* spp. in their nests (BENYAMINI, 1995, BENYAMINI & BÁLINT, 1995). However, no direct evidence of myrmecophily was found in the habitat and our assumptions are circumstantial.



Fig. 11. The habitat of *Pseudolucia balinti* sp. n. at 3640 m in Siera del Tontal (San Juan, Argentina) with *Astragalus arequipensis* host plant in the foreground (photo: O. Tomer)

Host plants in the type locality – Table 1 lists the localities where adults were observed and the presence of potential host plants there. It shows that during five visits, 15 habitats were the home of the blue; 14 habitats included *Adesmia* plants (Fig. 14), ten habitats included *Astragalus* (Fig. 15), three of which had few plants. Six habitats with *Adesmia* did not include *Astragalus* at all. Males and

Table 1. Habitats of *P. balinti* sp. n. at Sierra del Tontal and presence of its host plants. Acronyms of researchers: AB = Avishai Benyamini, DB = Dubi Benyamini, EB = Eran Benyamini, OT = Ofir Tomer, Dr Robert Kiesling of IADIZA participated in the 2010 expedition

<i>Ps. balinti</i> present	<i>Astragalus</i> present	<i>Adesmia</i> present	Latitude, longi- tude	Elevation (m)	Researcher	Date
yes – 1st record	no	yes	31° 32' 58.95" S, 69° 13' 3.57" W	3308	DB/AB/EB	15.12.2009
yes	yes	yes	31° 31' 32.81" S, 69° 12' 59.44" W	3497	DB/AB/EB	15.12.2009
yes	yes	yes	31° 31' 11.22" S, 69° 12' 28.87" W	3700	DB/AB/EB	15.12.2009
yes	few	yes		3750– 3928	DB/AB/EB	15.12.2009
yes	no	yes	31° 32' 42.81" S, 69° 13' 4.84" W	3340	DB/OT	29.11.2010
yes	no	yes		3450	DB/OT	29.11.2010
yes – 1st egg laid	yes	few	31° 31' 23.14" S, 69° 12' 8.55" W	3640	DB/OT	29.11.2010
?	yes	yes	31° 31' 6.09" S, 69° 11' 37.13" W	3750	DB/OT	29.11.2010
yes	no	yes	31° 33' 14.71" S, 69° 13' 5.02" W	3273	OT	3.12.2011
yes	yes	few	31° 31' 43.24" S, 69° 12' 33.15" W	3580	OT	3.12.2011
no, too cloudy, cold & windy	few	yes	31° 30' 48.32" S, 69° 12' 2.33" W	3928	OT	3.12.2011
yes	yes	few	31° 31' 43.24" S, 69° 12' 33.15" W	3580	OT	5.12.2011
yes - lower limit	few	no	31° 30' 44.25" S, 69° 13' 30.74" W	3201	DB	9.12.2011
yes	no	yes	31° 31' 0" S, 69° 13' 12" W	3330	OT	9.12.2011
yes	no	yes	31° 30' 55.13" S, 69° 13' 27.94" W	3238	DB/OT	9.12.2011
yes	yes	few	31° 31' 43.24" S, 69° 12' 33.15" W	3580	DB/OT	9.12.2011

females visited the *Adesmia* very often, but no egg-laying was observed. The conclusion is that *Adesmia* and *Astragalus* (both Fabaceae) are host plants, namely: *Astragalus arequipensis* Vog., *Adesmia horrida* Gillies ex Hook. & Arn., *A. echinus* C. Presl., *A. aegiceras* Phil. and *A. uspallatensis* Gillies ex Hook. & Arn.

Enemies and competitors – At the breeding site, large black or metallic blue wasps landed on the host plant, fast-flying syrphids were circling it and few lizards were seen on and around the plant. A red mite was observed attacking and killing an L1 larva. *Colias flaveola* was competitor using the same *Astragalus* as larval host plant, and a blister beetle of the Meloidae family as a leaf-eater.

DISCUSSION

Discovery – On 15.12.2009, an expedition to Sierra del Tontal, east of Barreal, Calingasta, San Juan, Argentina was organised by the author. Avishai and Eran Benyamini, his sons, participated. We followed the dirt road to the huge TV and communications antenna, which was located at the top of Tontal ridge. At 3238 m, 31° 33' 26.8" S, 69° 13' 9.5" W (Nikon, GP-1 Camera GPS reading) the first concentration of thorny *Adesmia* (Fabaceae) bushes began to appear. Here, around and on the bushes at 13:30 hours, the first males and females of *Pseudolucia* were observed, photographed and collected. On this date the blues were observed at least to 3750 m. A year later, on 29.11.2010, driven by the Argentinean botanist Dr Roberto Kiesling of IADIZA (Mendoza), the author and his colleague Mr Ofir Tomer returned to the type locality, where early season windy, cloudy and cold weather (± 17 °C) delayed the blues' activity until 12:40 when the first male was observed. Only six males and one female, all fresh specimens, were observed in the next two hours. We proceeded upwards, heading east along the ridge to our left and at 14:40, at 3640 m, 31° 31' 24.9" S, 69°



Figs 12–13. *Pseudolucia balinti* sp. n. on *Adesmia* sp. host plant, Sierra del Tontal (San Juan, Argentina) 3250 m: 12 = perching male, 9.12.2011 (photo: D. Benyamini), 13 = female, 3.12.2011 (photo: O. Tomer)

12' 27.9" W among few *Adesmia* bushes appeared many *Astragalus arequipensis* Vog. host plant of numerous *Colias flaveola*. Here for the first time I noticed that



Figs 14–15. Larval host plants of *Pseudolucia balinti* sp. n., Sierra del Tontal (San Juan, Argentina): 14 = *Adesmia echinus*, 3900 m, 2.12.2011 (photo: O. Tomer), 15 = *Astragalus arequipensis*, 3580 m, 9.12.2011 (photo: D. Benyamini)

most of the blues' activity was around dry *Astragalus* plants, but females landed quite often on the fresh flowering ones. At 14:50 a female landed on an *Astragalus* plant and laid an egg on a leaflet. The blues' activity lasted until 15:50, and up to 3750 m. On this occasion, I failed to breed the lycaenid because of lack of time and fresh host plants. A year later, in early December 2011, we returned for our third visit, this time staying longer aiming to breed the butterfly. On 3.12.2011 some 20 blues, mostly males (Fig. 16) were observed by Ofir Tomer at the 3640 m breeding habitat. Although no more egg-laying was observed, some *A. arequipensis* host plants were collected for further study at our cabaña/field laboratory at Barreal. The blues were observed along the road to the TV antennas at the top of the Tontal ridge at 3928 m. On 5.12.2011, the eastern side of the mountain behind the antennas was visited by Ofir Tomer, but strong and cold winds with snow prevented study. On 9.12.2011, we conducted our last visit; at a small green valley at 3201 m, one male was observed around a single *A. arequipensis* host plant at this locality, but no *Adesmia* bushes were observed. Adults were active along the road to the summit, but at the top near the antennas sudden clouds, mist and cold winds prevented butterfly activity.



Fig. 16. Resting *Pseudolucia balinti* sp. n. male with closed wings in cold winds on *Adesmia* in Sierra del Tontal (San Juan, Argentina), 3580 m, 3.12.2011 (photo: O. Tomer)

Breeding and switching host plants en route – On 10.12.2011, we left Barreal for the capital San Juan, where we organised the trip to Northern Argentina, driving a rented car. The *Astragalus arequipensis* host plant dried out rapidly and on 12.12. when we left San Juan for La Rioja all the leaves and flowers had dried and larvae started to feed on the petioles; they did not consume the fruits. On 13.12 they were starving and actually did not move in the plastic breeding box. On 14.10, we headed west towards Laguna Brava (La Rioja) but not a single *Astragalus* was found along RN76. Finally, at midday at an altitude of 3917 m, the author located *Adesmia echinus* in bloom and at 3978 m *A. nanolignea* Burkart (det. E. Ulibarri). Short branches with young leaves, flower buds and flowers were offered to the larvae on the spot. In the evening at 22:00 two L4–L5 larvae were observed boring into the flowers. This fast transfer proves again that *Adesmia* is an acceptable host plant to *P. balinti* at the Tontal Ridge. Two days later at Catamarca we were heading to Paso San Francisco along RN60. At 3286 m, fresh *A. horrida* and *A. erinacea* Phil. (det. E. Ulibarri) with numerous flower buds were collected and offered to the larvae. But they refused these alternatives and continued to feed on the leaves of *A. echinus* from Laguna Brava. On 17.12, between Santa Maria (Catamarca) and Tafi del Valle (Tucuman) a 30 cm tall *Astragalus garbancillo* Cab. (det. L. Novara) with white-pink flowers was collected near the road. Its small hairy leaflets looked identical to *A. arequipensis*. The fresh *Astragalus* immediately attracted one of the larvae, which started to feed on the flowers. The next day, on 18.12 both larvae had accepted the *Astragalus*. On 22.12 fresh flowers of *A. garbancillo* from Coraya, Humahuaca, Jujuy were offered and accepted by both larvae. This was their fourth and last supply of alternative host plants. On 26.12, one larva assumed a pre-pupal appearance and on 28.12 pupated. The adult (male) eclosed on 8.1.2012. Originating from Sierra del Tontal it travelled by road some 2500 km, crossed seven Argentinean provinces, changed host plants four times, flew some 2200 km to South Chile and back, to finally hatch in Santiago de Chile, altogether ca 7500 km.

Host plant utilisation – In 1995 the author constructed for the first time a host plant family tree for a Neotropical lycaenid genus (BENYAMINI 1995: 32, Fig. F). VILA *et al.* (2011) repeated it on a larger scale, supporting their DNA sequencing results. Benyamini showed that 21 Chilean *Pseudolucia* with known host plants were actually divided only to four species groups: 1) the *chilensis* feeding on *Cuscuta* (Cuscutaceae); 2) the *collina* feeding on *Montiopsis/Calandrinia* (Portulacaceae/Montiaceae) and later in season when available on *Chorizanthe* (Polygonaceae); 3) the *andina* feeding on *Astragalus* (Fabaceae) and 4) the *plumbea-sibylla* feeding on *Adesmia* (Fabaceae). As the research advanced, more species were bred and 19 new *Pseudolucia* species were added, but the ‘rules’ of the host plants’ family tree were kept strictly and no single species of the 43

known by 2011 crossed the lines to feed on a different plant genus. Furthermore, the additional new species (will be described by the author in collaboration with Zsolt Bálint), bringing the total number of species of *Pseudolucia* to 54, complies with the 'rules' of the host plants' family tree. The limited number of host plant genera used clearly indicates a recent speciation within the *Pseudolucia* genus.

The discovery that *P. balinti* sp. n., a member of the *plumbea-sibylla* species group, is the only one feeding naturally on genera of both *Astragalus* (as the main host plant) and *Adesmia*, is of great systematic importance. It suggests that this new species, which is located at the base of two different host plant branches (Fig. 17), is the source of the *andina* and *plumbea-sibylla* species groups.

This hypothesis is further supported by additional facts.

1) *Pseudolucia balinti* sp. n. is an isolated population; Sierra del Tontal, its habitat, is a north-south mountain chain of the Argentinean Precordillera. It runs parallel to and east to the Andes, 95 km across Valle de Calingasta (alt. 1600 m) and 65 km east of Cordillera de Ansilta (see Fig. 1), where another representative of the *plumbea* species group flies (BÁLINT & BENYAMINI 2013). Therefore, both species are separated by a 2500 m deep and 65 to 95 km wide, warm and dry (in summer) steppe, where they cannot breed or survive.

2) Three more isolated and exceptional butterfly records further emphasise the isolation of this ridge.

2a) A new subspecies of *Yramea modesta* (Blanchard, 1852) (Nymphalidae, Heliconiinae) was found at the high part of Sierra del Tontal and will be described soon (Benyamini, *in prep.*).

2b) The pronophiline species *Argyrophorus monticolens* (Butler, 1881), known to fly in the Chillán and Bio-Bio regions in southern Chile, was collected in mid-December 2009, up on the ridge at 3700 m and was positively identified by the satyrid specialist Dr Tomasz Pyrcz of Krakow University, Poland. This record is many hundreds of kilometres north of its nowadays permanent population (across the Andes in southern Chile), and deserves a new subspecific rank.

2c) *Colias flaveola*, known from elevations of 3000 to 3200 m in the Andes, has a flourishing colony at Sierra del Tontal at 3600 to 3700 m. The specimens are larger than the nominate *flaveola*, having a different *Astragalus* host plant, but possibly not yet deserving of a different subspecific rank (J. Verhulst, pers. comm.).

The Argentinean Precordillera antedates the Andes (GERBI *et al.* 2002, KELLER 1999) and quite possibly, like Cordillera de la Costa in Chile, both were the origins of the entire *Pseudolucia* genus. Therefore, while the Andes were rising up, their eastern and western slopes evolved a long speciation process lasting to present day and resulting nowadays in different *Pseudolucia* species on either side, where the continental divide serves as an unseen barrier along its central

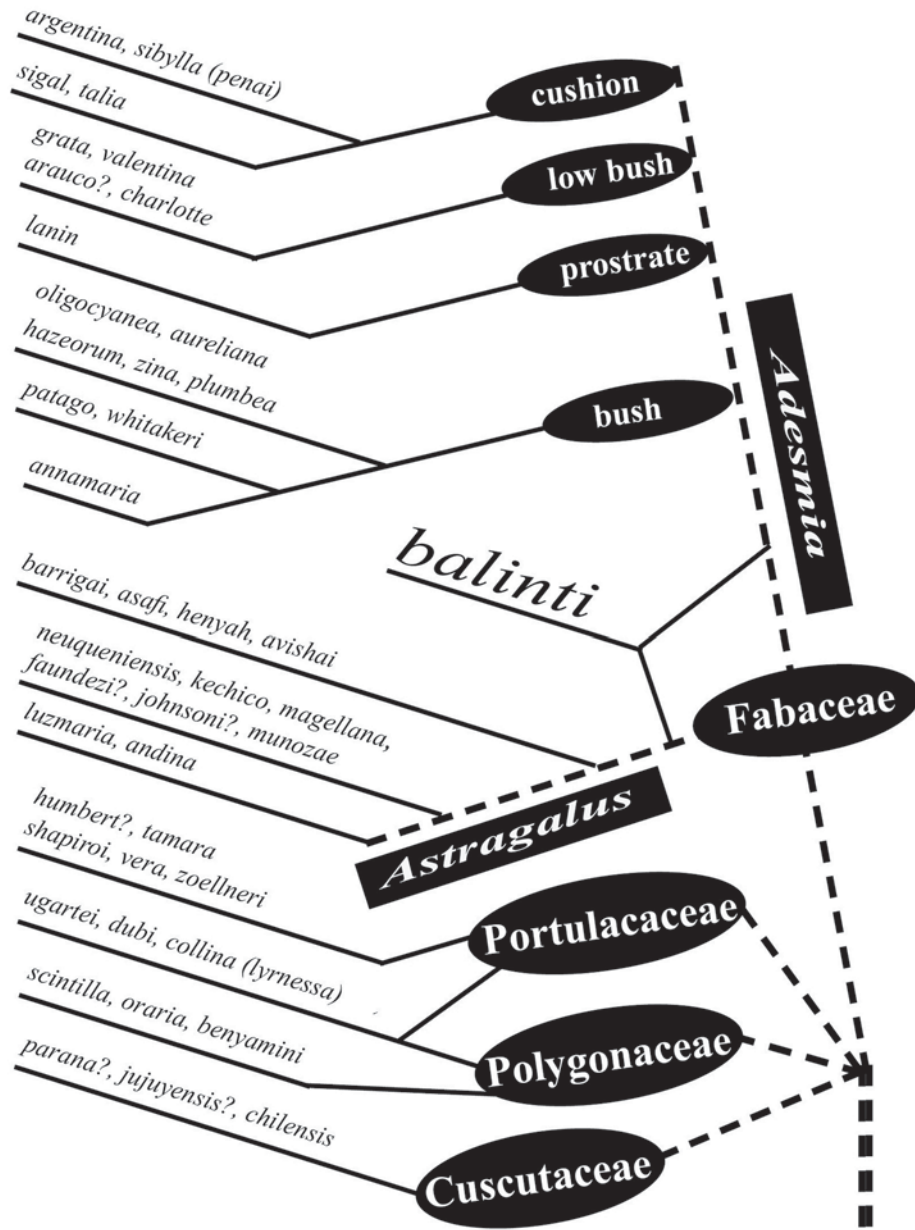


Fig. 17. Host plant family tree of all described species of *Pseudolucia* Nabokov, 1945 (by 2011), with *Pseudolucia balinti* sp. n. located at the junction of *Astragalus* & *Adesmia* feeding genera. Species with question mark was not bred or regarded as extinct, but believed to belong to the host plant branch as indicated (credit: L. Benyamini)

and northern higher parts. At the same time, the lowland Argentine Patagonian steppe and the western side of the Andes in Chile developed other branches/species of the genus.

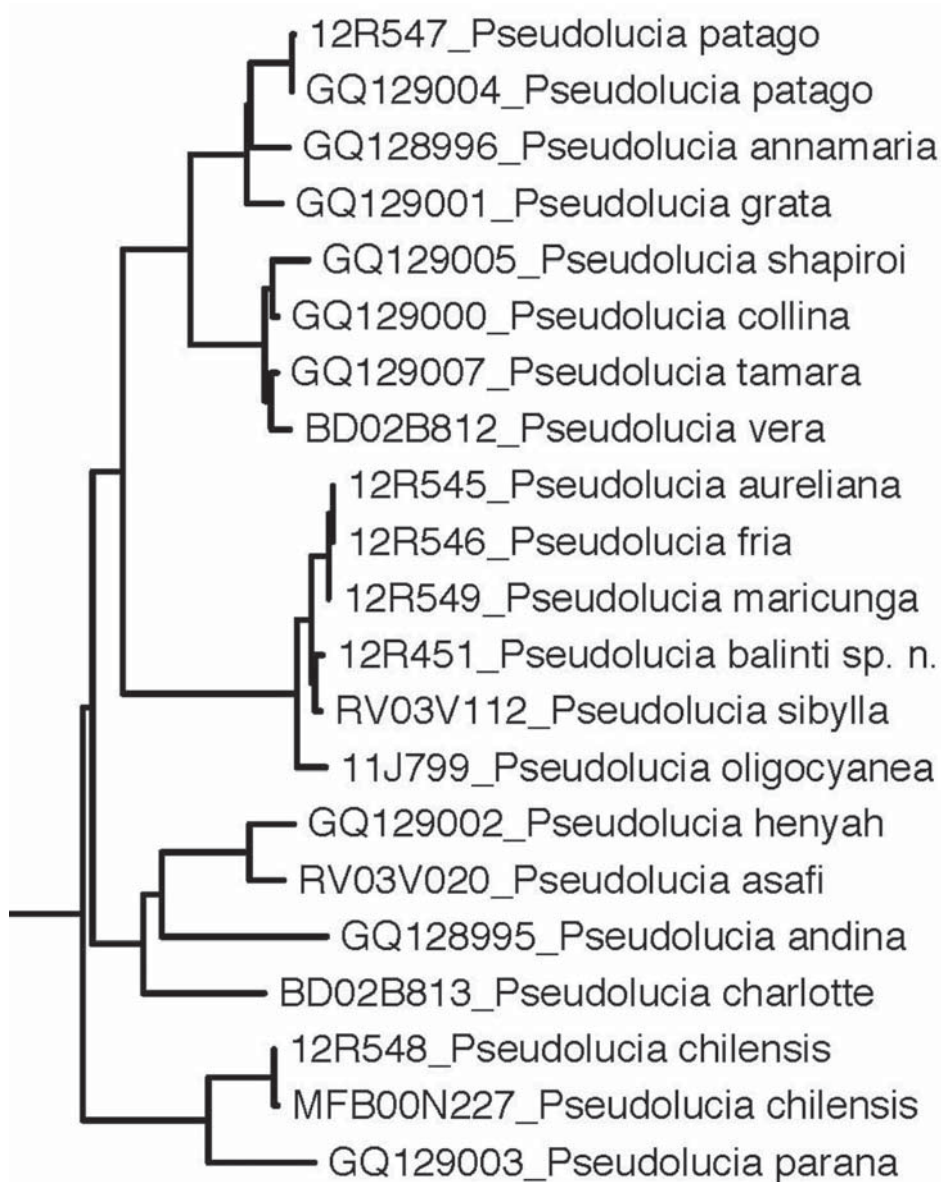


Fig. 18. Result of a preliminary DNA barcoding research showing the position of *Pseudolucia balinti* sp. n. within *P. sibylla* clade (credit: R. Vila)

3) DNA barcoding preliminary results for *P. balinti* sp. n. (Fig. 18) made by Dr Roger Vila (Institute of Evolutionary Biology, CSIC-UPF, Barcelona, Spain) based on COI mitochondrial data shows that *P. balinti* sp. n. forms a clade together with *P. aureliana*, *P. oligocyanea*, *P. maricunga* and *P. sibylla*. This clade is relatively isolated from other species of *Pseudolucia* studied, but differentiation among the species in the clade is recent, as demonstrated by small genetic divergences. Consequently, precise relationships between *P. balinti* sp. n. and closest relatives are unsupported, although it seems to be most closely related to *P. sibylla*.

*

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